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13th Global Conference on Sustainable Manufacturing - Decoupling Growth from Resource Use

Sustainable urban mobility through the perspective of overcompliance

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Dorothea Kübler^{b,c}, Günther Seliger^a^a Department of Assembly Technology and Factory Management, Technische Universität Berlin, Pascalstraße 8-9, 10587 Berlin, Germany^b WZB Social Science Center Berlin, Reichpietschufer 50, 10785 Berlin, Germany^c Faculty of Economics and Management, Technische Universität Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany* Corresponding author. Tel.: +49-30-314-21255; Fax: +49-30-314-22759. E-mail address: koesemf@mf.tu-berlin.de**Abstract**

Being at the frontier with regard to sustainable aspects of manufacturing may serve as competitive advantage due to the increasing trend of consumer awareness. In order to adhere to the consequent pressure from external stakeholders such as customers, investors, competitors, interest groups and local municipalities, companies voluntarily overcomply with social and environmental norms. This paper explores the incentives for the industry to embrace overcompliance as a strategic means to gain competitive advantage and take the lead in sustainable manufacturing. Examples from recent industrial trends are used to present the relevance of the combination of overcompliance and sustainability in the field of mobility. Studies of the Collaboration Research Center 1026 are presented as additional examples of strategic overcompliance with emission standards in the field of sustainable urban mobility.

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Keywords: sustainable manufacturing; voluntary overcompliance; urban mobility**1. Introduction**

Sustainability refers to meeting human needs without overburdening nature and principally aims for higher economic, environmental and social standards in different areas of human living [1]. Overcompliance is instantiated as the overfulfilment of standards that relate to environmental and social sustainability. As consumers' awareness towards corporate responsibility increases [2], opportunities arise through overcompliance strategies. Businesses can gain access to new customer segments, reduce legislative pressure and fend off anti-company lobbying activities. The effects of this strategy are however uncertain, as it relates to individual values and preferences in different cultural frames.

This paper addresses overcompliance and sustainability from the viewpoint of shared motives and goals incentivising these industrial trends. It summarises the evolution of sustainability in terms of regulatory compliance and voluntary overcompliance in Chapter 2. In addition to the motives and goals of performing beyond the regulatory limits in favour of sustainability, the implementation and gained benefits are

explained in Chapter 3. Following a brief introduction to urban mobility, recent industrial trends in this field are explored from the shared perspective of overcompliance and sustainability in Chapter 4. Studies of the Collaboration Research Centre (CRC) 1026 "Sustainable Manufacturing – Shaping Global Value Creation" in the field of sustainable urban mobility are also introduced in this chapter.

2. From compliance to overcompliance

The idea of sustainability originates in the environmental movement that started drawing attention in the 1960s, when pressing problems such as water and air pollution were surfacing in an increasing number of crowded urban areas [3]. The initial resolution of these issues represented the environmental problems as a consequence of the difference between the *market price* faced by the consumers and the *true price* paid by the environment and ultimately the consumers themselves. The proposed countermeasure was the introduction of surrogate prices in the form of taxes or fines for the use of

certain scarce environmental resources, such as clean air and water [4].

Rising public concerns supported the initial policies that aim to control the industrial practices economically through strict auditing and violation procedures. Companies adopted environmental codes of conduct and auditing programs, in order to avoid the potentially high costs of fines, legal cases and negative publicity [5]. As a result of the increasingly stringent and multifaceted legislations, the term *regulatory compliance* surfaced in the global industrial landscape and denoted the strategic objective to conform to social and environmental regulations.

Conventional policies stemming from this era prescribe the quantity limits on detrimental emissions and specify fines for violations. In the last decades, this regulatory regime of restrictions and fines has contributed to a better protection of the environmental and social well-being. However it also put the major focus of the measures on the reduction of emissions and encouraged ex-post solutions (e.g. end-of-pipe techniques, offsite treatment or even illegal dumping and landfilling) rather than in-depth pollution prevention [6,7]. Economic viability outweighed environmental sensitivity [8] and the ethical expectations of the society [9]. Additionally, the monitoring and enforcement activities have major additional disadvantages for both policymakers and industry. On the one hand, protracted development and enforcement processes are occupying a large amount of resources [9–11]. On the other hand, possible resource cutbacks and associated downturns in government and public pose vulnerability to inconsistent and inadequate enforcement [12]. Inflexibility and over-formality of jurisdictional constraints on the subject matter, approach and scope cause a heavy bureaucratic burden [9].

These drawbacks triggered improvements in policymaking. The United Nations Conference on the Human Environment (1972) highlighted the need for more comprehensive actions [13] and resulted in a series of international efforts (e.g. United National Environmental Program, 1972; The International Environmental Educational Program, 1975; The World Conservation Strategy, 1980). In 1987, the United Nations World Commission on Environment and Development published the report 'Our Common Future', a milestone in the environmental revolution and the first publication that uses the term "sustainable development" [1].

In parallel with the emergence of sustainability thinking, the perspective of research initiatives broadened from simplistic emission-limiting measures to sophisticated life-cycle oriented solutions. End-of-pipe pollution treatment methods are substituted with ecological modernisation investments [14]. Governmental agencies, non-governmental organisations, industrial associations and individual companies introduced various standards and other voluntary codes complementing strict disincentives. Policymakers promoted these non-mandatory policies such as reporting of operational records and implementing best practices as an extension to the regulations [15]. Reactive measures are being transformed into proactive efforts that shift the industrial practices beyond compliance levels. As a consequence of the increasing adoption of such voluntary actions [16] the term, *voluntary overcompliance* is

coined for the business phenomenon where firms are performing beyond the mandatory compliance levels [17].

3. Sustainability and overcompliance

3.1. Shared motives and goals

Sustainability refers to meeting the needs of current and future human generations without overburdening the nature. It aims at higher economic, environmental and social standards in different areas of human living [1] and requires shifts in organisational activities, structures and cultures in practice.

Traditionally the shifts towards higher standards are initiated through regulations, which suggest that improving economic efficiency and environmental impacts results in better social conditions. However, this approach may not ensure the prosperity and well-being of society in every case. The integration of economic, social and environmental aspects that go beyond those specified by regulations and standards is the core objective of voluntary measures leading towards sustainability. In other words, resource allocations that target achieving more sustainable practices can also lead to overcompliance with the existing regulations.

Resource allocations in a company that target achieving a higher level of sustainability go through complex decision-making processes. The decision-making environment of a company is a conglomeration of stakeholders within its social, political and economic domains [18–20]. It accommodates shared channels of dialogue, discussion and negotiation over social, financial, legal and political interests, beliefs, concerns and expectations [21]. The essential entities influencing the decisions through these channels are: 1) Exchange partners (e.g. customers, retailers, suppliers), 2) Sources of funding (e.g. financial institutions, shareholders, investors), 3) Regulatory bodies (e.g. state agencies, courts, international authorities), 4) Professional institutions (e.g. trade associations, academic institutions) and 5) Special interest groups (e.g. religious institutions, local communities).

Since an increasing part of the population is supporting the initiatives with good environmental performance and social responsibility [2,8], more and more companies screen their value-creation networks for potentials to improve their sustainability, thus to increase their competitiveness [22]. As a result, the guiding principles of overcompliance imply certain motives and goals in different practical contexts for improving sustainability (Table 1).

Various studies cover the company, industry or case specific characteristics underlying these motives and goals to govern the externalities such as regulatory pressure, competitive pressure and stakeholder pressure (Table 2). The most studied advantage of overcompliance in literature is its potential to reduce regulatory pressure. By voluntarily elevating their existing social and environmental profiles, companies mitigate the present and future risks attached to the regulations [23–26]. As one of the most important risks of non-compliance, negative market reactions such as boycotts, protests or other anti-company lobbying activities by consumer organisations are also prevented [6,15,27].

Table 1 Sustainability contexts and associated motives and goals of organisational behaviour [21]

Context	Motives and goals
Operational efficiency	Reducing costs, increasing yield and utilisation through process optimisation
	Reducing resource allocations for liability, control and disposal management
	Exploring opportunities for streamlining process components and maintenance procedures
Risk Management	Lowering insurance premiums by limiting liability exposure and waste-disposal liability risks
	Eliminating the need and associated costs of contingent emergency procedures
	Securing exit strategies by remaining alert to changes in media attention, community concerns and regulatory trends
Capital Acquisition	Reducing the risks of corporate transactions by integrating environmental considerations into the investment processes
	Gaining business and tax advantages by uncovering hidden environmental liabilities in property acquisitions and divestitures
	Reducing the operating expenses of new facilities by incorporating environmental considerations into the initial design
Human resource management	Attracting high-class professionals based on a strong social and environmental reputation
	Increasing employee productivity and work output through improved working conditions
	Improving competitiveness through motivation and commitment of the employees
Strategic direction	Having a better control over resource allocations by attending to modern industrial trends
	Widening the value creation network by appealing to companies seeking strategic advantage through their own initiatives
	Reducing the legislative pressure through pre-empting future regulations
	Increasing the competitiveness by elevating industry standards
	Securing new businesses by enhanced corporate attributes and protecting existing ones from external criticism and protest
Market demand	Reaching new market segments by introducing differentiated products and services
	Enhancing the company's public image and credibility by appealing to socially and environmentally conscious consumers
	Establishing a positive psychological notion by making customers feel good by doing <i>good</i>
Social Responsibility	Increasing the well-being of people in company's social network by introducing more sustainable goods and practices
	Extending the public reach by tightening human relations at every level and platform
	Gaining a leading role in the society and business field by setting an example for appropriate practices

Table 2 Studies on motives and goals underlying overcompliance decisions

Regulatory pressure	Competitive pressure	Stakeholder pressure
[6,20,23–26,28–32]	[30,33–35]	[6,15,20,32,33,36–38]

In a game theoretic model of a three-stage game between companies and consumers, Maxwell et al. explore potential channels through which the threat of stricter regulations can lead to overcompliance [25]. In the first stage, each company sets its emission standards and can therefore decide to overcomply with legal standards. In the second stage, consumers can decide to lobby or take legal action against companies. In the third stage, the companies compete on a market to sell their product to the consumers. In equilibrium, companies overcomply to prevent consumers from lobbying. Thus, overcompliance increases firm profits in this setting.

Schmid has tested this model empirically in a controlled environment by running an economic laboratory experiment on students, who were asked to take up the role of either company or consumer [39]. The results show that students in the role of companies learn to overcomply with existing standards and that this successfully prevents consumers from lobbying or taking legal action. Thus, overcompliance led to increased profitability in this setting even though it is costly in the first place.

The result of strategic overcompliance by firms is somewhat surprising as the decisions of students in the role of firms are not straightforward. They need to understand that the higher cost from overcompliance pays off because overcompliance changes *the game* played by the other participants in the role of consumers or legislators. In this sense, companies do indeed see the strategic advantages of more sustainable production technologies given consumers are educated.

3.2. Application and competitive advantages

Companies can utilise different approaches and resources by responding to the concerns and interests of their stakeholders. While the decision making process is dependent on companies' core business functions and status [20,21], strategies are also configured according to the options (e.g. public programs, collaboration projects and bilateral or multilateral agreements) provided by regulatory bodies, non-governmental organisations or industrial and trade associations as market-based, voluntary extensions to the regulations (Table 3) [40]. These options are instances of integrated approaches to sustainability and overcompliance. They possess the strategic economic benefits of overcompliance highlighted in the previous section, whilst achieving the social and environmental goals of sustainability. Companies can thereby meet the agreed targets in exchange for public recognition, technical or financial assistance, exemptions or leniency in regulatory enforcement. Moreover industrial cooperation opportunities may be essential for smaller companies that seek know-how on best practices [16,41].

Table 3 Examples of public programmes, bilateral and multilateral agreements offered by different initiatives [40]

Country	Scheme
Australia	Greenhouse Challenge
Belgium	Auditing Covenant
Denmark	Agreements on Industrial Energy Efficiency
Estonia	Environmental Charges Act
EU	Eco-Management and Auditing Scheme
Finland	Agreements on the Improvement of Energy Efficiency
France	AERES Negotiated Agreements
Germany	National Climate Protection
Indonesia	Program for Pollution Control Evaluation and Rating
Ireland	Energy Agreements Program
Japan	Keidanren Voluntary Action Plan on the Environment
Netherlands	Benchmarking Covenants
New Zealand	Negotiated Greenhouse Agreements
Slovenia	CO2 tax and voluntary agreements
Switzerland	CO2 Law Voluntary Measures
Taiwan	Energy Auditing Program
UK	Energy Efficiency Agreements
USA	Project XL Agreements on environmental innovation

In order to allocate their resources in the most suitable way organisations may choose to develop their own policies, which would assist them in complying with or exceeding pre-existing statutory or regulatory requirements [9]. Since retaining or gaining competitiveness is of major importance for any of such self-initiatives, economic aspects are coupled with environmental and social aspects such as resource depletion, energy consumption, land use, toxic/hazardous emissions, occupational safety and health, fair trade, stakeholder empowerment, educational and personal development capabilities. For example, General Electric's Ecomagination is a business initiative that is based on the voluntary commitments to research and development with the aim of reducing harmful environmental impacts and generating profitable growth for the company. Within three years after the launch of the program, GE generated \$100 million in cost savings and \$17 billion in annual revenue through 80 new products and services that use less energy and water and cause less GHG emissions [42]. In a similar attempt, Samsung's Eco-Management program seeks competitive advantages through overcomplying in different sustainability aspects such as climate strategy, eco-friendly products, take back policies and recycling. In 2009, the results of the program showed a 69% (9% more than planned) market growth for Samsung's environmentally friendly products (i.e. Good Eco-Products) [43]. SAP is another notable example for achieving profitability and sustainability. SAP's commitment to sustainability includes various environmental and social investments such as NGO partnerships and donations, gender equality at management levels, renewable energy sourcing and e-waste recycling. From 2010 to 2014 the company increased its total revenue by €5 billion, while it lowered its GHG emissions per € revenue from 36,3 grams to 28,4 grams [44].

4. Sustainable urban mobility through voluntary overcompliance

4.1. Sustainable urban mobility

Mobility is one of today's major technological challenges. Starting from the early 20th century, automotive industry has risen to the top by providing mobility for public transportation, logistics and personal demands. Massive road infrastructures and motorised vehicles have transformed the scenery in cities. The dominant dependency of urban mobility on non-renewable resources has increased the burden on the environment radically, not the least by deteriorating the air quality in various urban areas. Although vehicle emission standards and regulations (e.g. EU Regulation No 443/2009, EU Regulation No 510/2011) are enforced and manufacturers' compliance is already established, greenhouse gas (GHG) emissions stemming from urban transportation are still often above the levels that can be compensated in terms of social and environmental sustainability [45].

In order to support the voluntary efforts to go beyond regulatory compliance, the EU Framework Programme for Research and Innovation - Horizon 2020 introduced the "Smart, Green and Integrated Transport" as one of its societal challenges. Public and industrial initiatives are incentivised and encouraged to explore the improvement potential regarding the transformation in the use of vehicles, more efficient and lower impact city logistics, and a reduction in urban road congestion, combined with a broad take up of cleaner vehicles powered by alternative fuels and drive trains [46].

While environmentally friendlier automotive products (e.g. electric cars, hybrid cars, fuel cell cars) are getting a lot of attention from the public and industry, transportation services that introduce new forms of vehicle use and ownership, such as car-pooling, car-sharing and ride-sharing, are notable examples as well. These new product-service-system (PSS) business models are designed to provide the functionality through increasing the utilisation of existing means of transportation [47]. They reduce the demand for new resources as individuals gain social and economic benefits by sharing the value [48] of commonly used resources.

A further focus is laid on cycling within the frameworks of urban planning directives and programmes such as DG MOVE, ELTIS, EPOMM and CIVITAS in addition to previously mentioned Horizon 2020. Projects for improving cycling infrastructure, promoting bicycle use and bicycle sharing are being developed and implemented in many different cities around the world. Several studies reveal the positive returns of these projects. By 2015, the number of bicycle sharing systems and the volume of their fleets account to a 20% annual growth rate and the global market is expected to be worth approximately 5 billion euros by 2020 [49]. Creutzig et al. indicate that the modal share in urban transportation could change in favour of non-motorised transportation [50].

4.2. Mobility in CRC 1026

The increasing demand for non-motorised transportation leads to an increased relevance to explore the potentials of

sustainable product development, manufacturing and business practices for cycling options. To that end, the CRC 1026 demonstrated interdisciplinary innovative solutions in the field of sustainable value creation for mobility, specifically for cycling. In parallel with the main theme of showing how sustainable value creation ensures economic wealth, environmental integrity and quality of life, different CRC projects contributed to the development, manufacturing, business modelling and end-of-life management studies for cycling products and services. Some of the physical prototypes of developed products are displayed in Figure 1.



Figure 1 (a) Bamboo bicycle; (b) Do-It-Yourself bicycle; (c) Wooden bicycle; (d) Smart Urban Wheeler concept

The products take their motivation from the pressing issues caused by the GHG emissions within urban borders. Since bicycles already comply with the regulations and are more sustainable than motorised transportation, development efforts aim to bring these products to even higher levels than the widely accepted standards. This is a prime example of overcompliance. It includes using environmentally friendlier materials (i.e. bamboo bicycle, wooden bicycle), simplifying user engagement by enabling the bicycle to be made by its owner (i.e. Do-It-Yourself bicycle) and integrating technical innovations to daily use (i.e. Smart Urban Wheeler).

The most comprehensive concept developed within the CRC is the electricity-assisted tricycle, the Smart Urban Wheeler (SUW). SUW embodies a large variety of qualities such as increased safety, improved comfort and ergonomics, high functionality, multi-person and heavy weight transportation, energy recovery, renewable energy utilisation, reduced noise pollution and connected communication technologies for smartphones (Figure 2) [51].

In addition to these design parameters, SUW production processes are realised in help-for-self-help cells with intuitive work design and interactive worker support. This highly adaptive and supported work setting ensures worker health and safety, enables the production activities to be carried out by workers with lower training or skill levels and to be transferred to any other location [52]. SUW is planned to be used in a sharing model, allowing the additional benefits of PSSs to complement this product and production concept in the use phase.

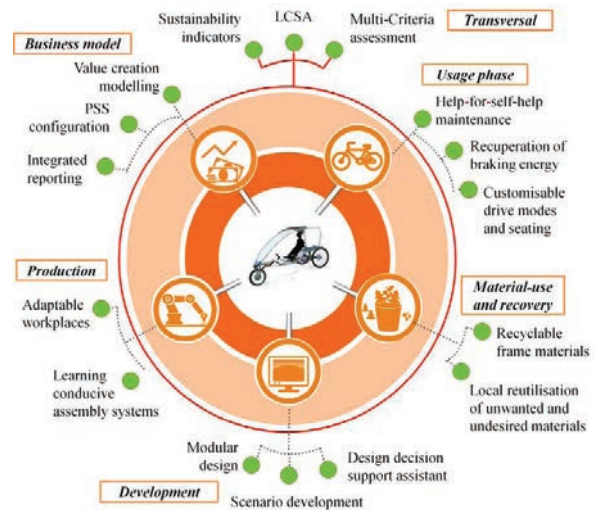


Figure 2 Overview of the SUW concept

5. Conclusion

This paper discusses the relationship between overcompliance and sustainability and reveals the common incentives for both industrial trends. Based on the findings, matching the goals and strategies of overcompliance and sustainability appears to be a promising option to drive public and private initiatives toward a sharing economy. The development of sustainable solutions can be a means of overcomplying with existing regulations. Overcompliance with social and environmental aspects can be set as the target for strategies that aim at improving sustainability.

In the manufacturing industry, benefits attached to overcompliance can be achieved either by differentiating existing product lines in favour of sustainability (e.g. electric cars, bamboo bicycles) or by introducing new products that can offer even higher sustainability (e.g. the SUW). Furthermore, the coupling of overcompliance targets with sustainable manufacturing activities has the potential of providing the required benchmark and feedback for improving the policies, regulations and standards in favour of responsible use of resources.

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